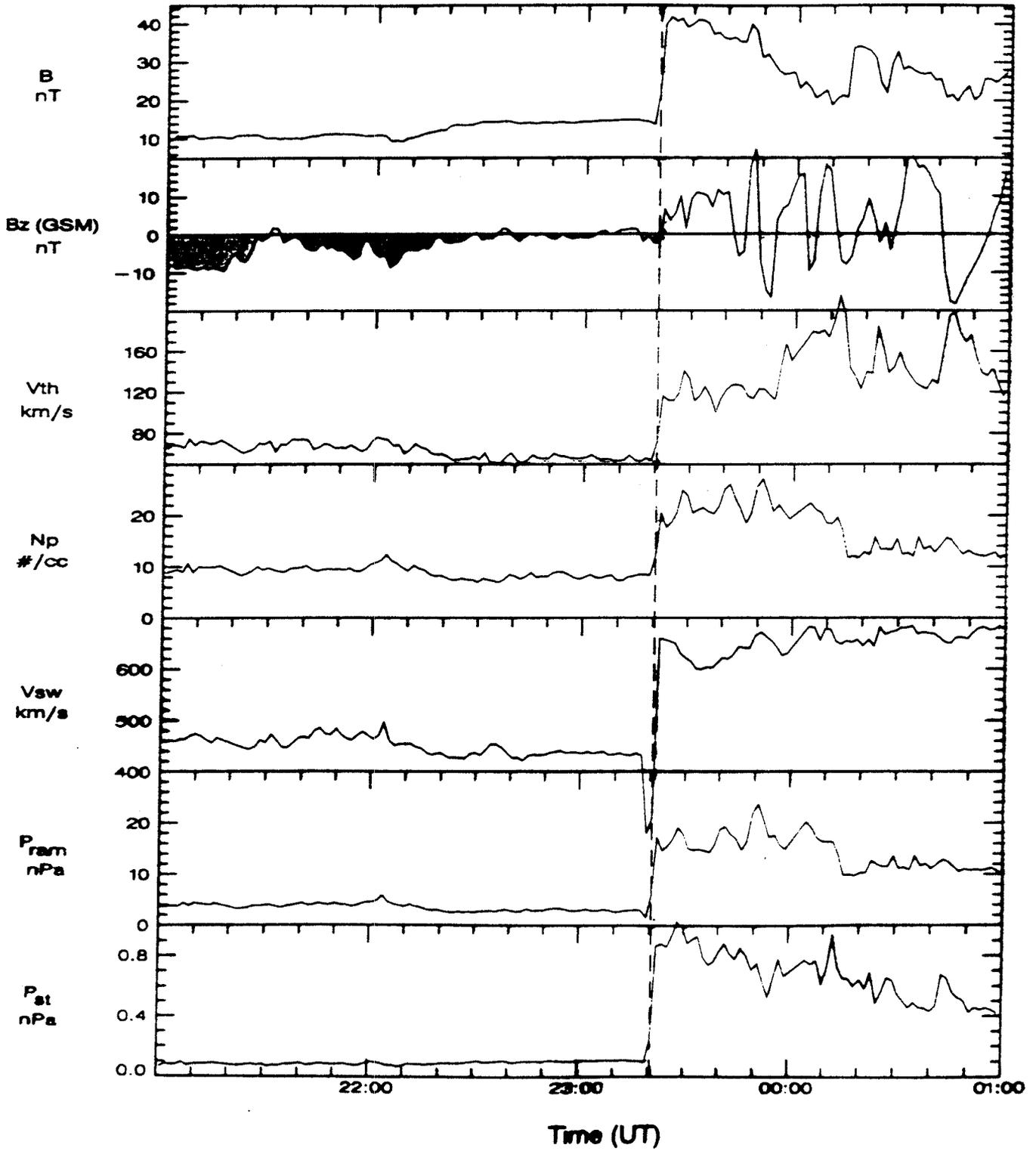


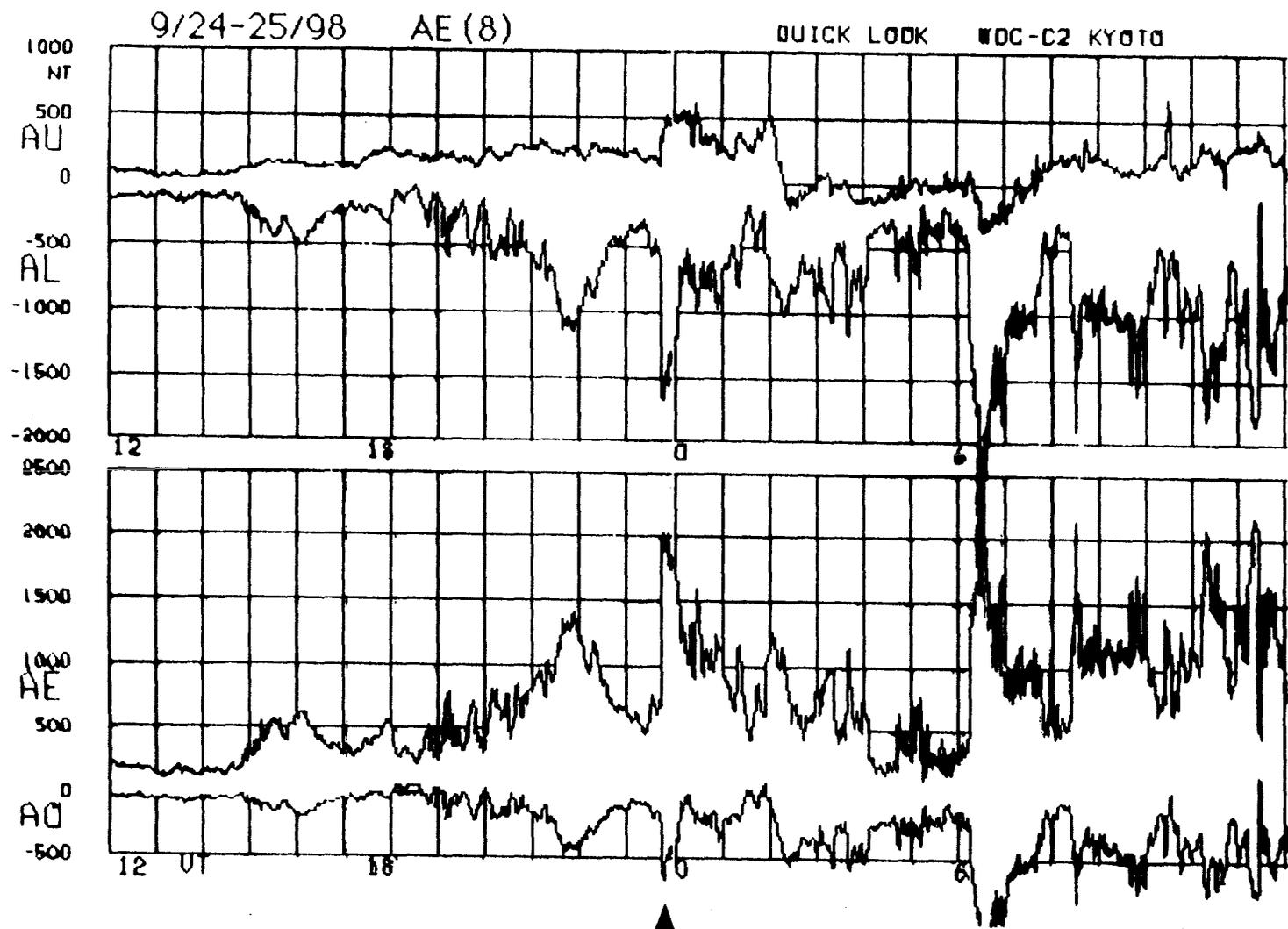
INTERPLANETARY SHOCK TRIGGERING OF AURORAL SUBSTORM ACTIVITY: A MECHANISM

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Jet Propulsion Laboratory, Pasadena, California

G.S. Lakhina
Indian Institute of Geomagnetism, Mumbai, India

WIND - September 24, 1998
Shock

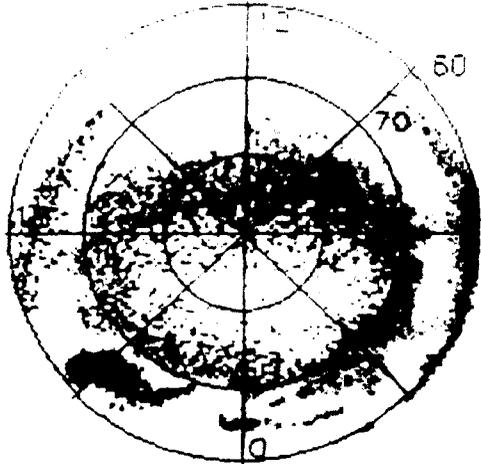




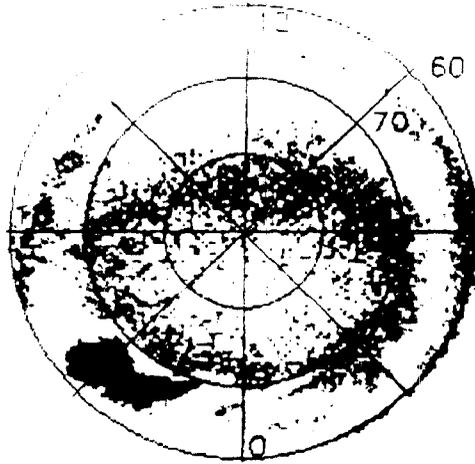
↑
IP shock triggered
substorm intensification

IP shock Arrival

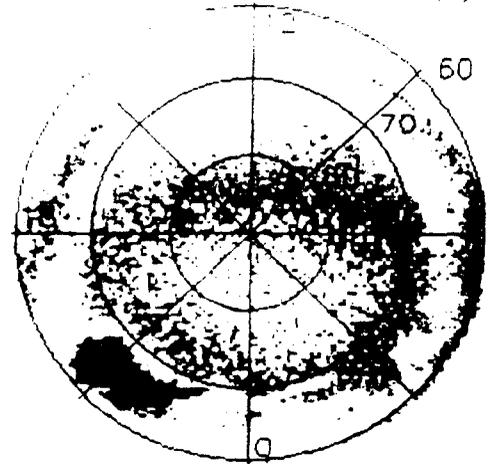
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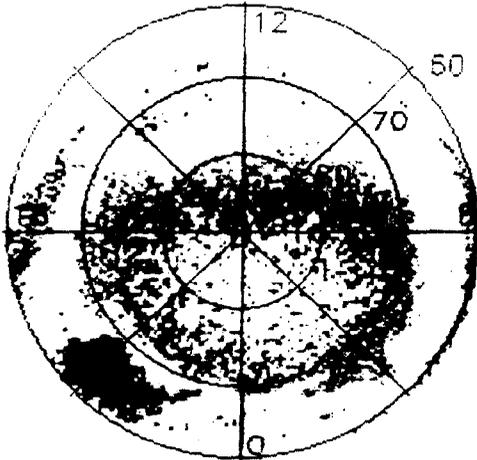
23:43:30 UT (b)



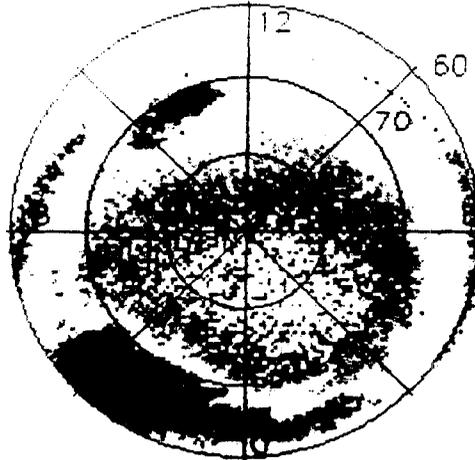
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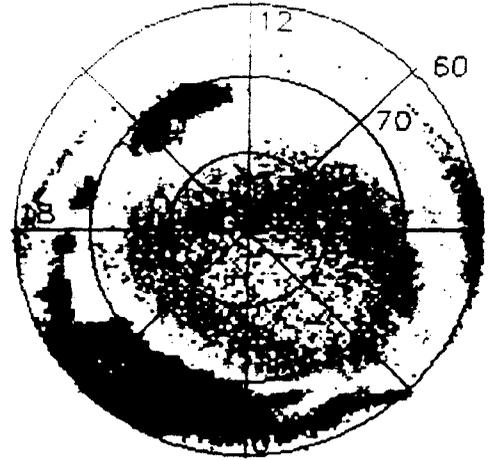
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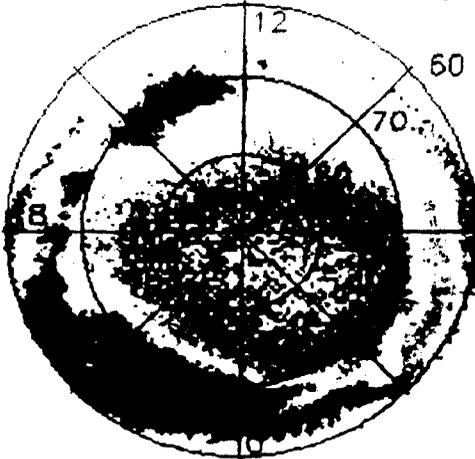
23:47:11 UT (e)



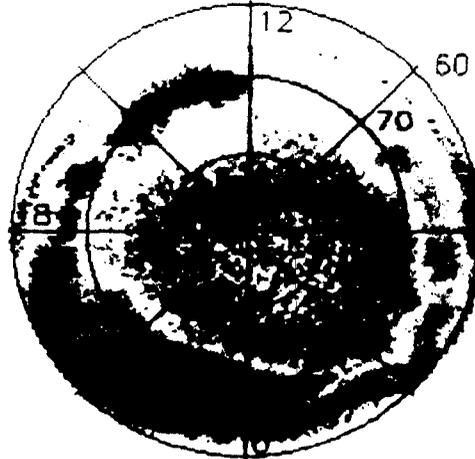
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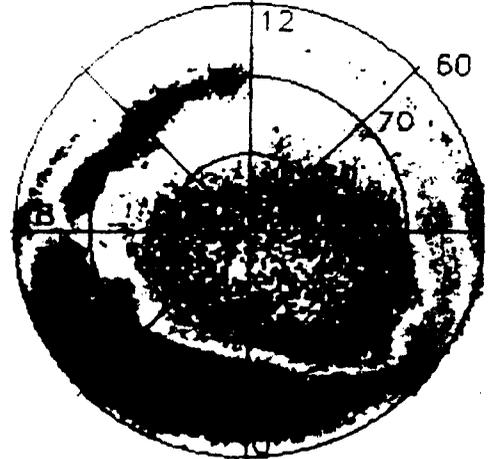
23:49:01 UT (g)



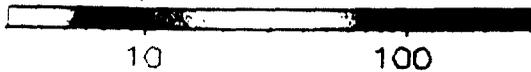
23:50:15 UT (h)



23:51:29 UT (i)

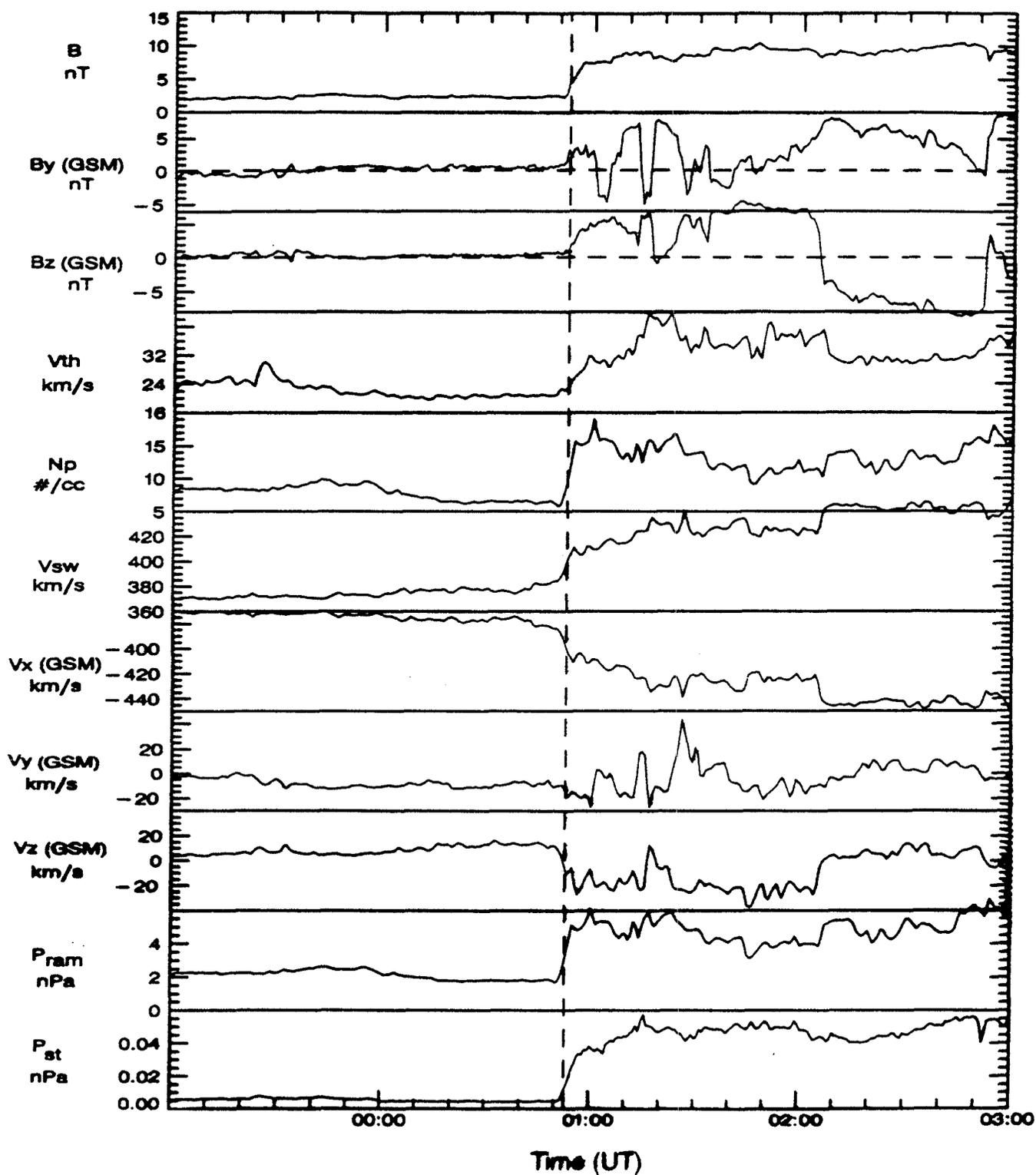


photons $\text{cm}^{-2} \text{s}^{-1}$

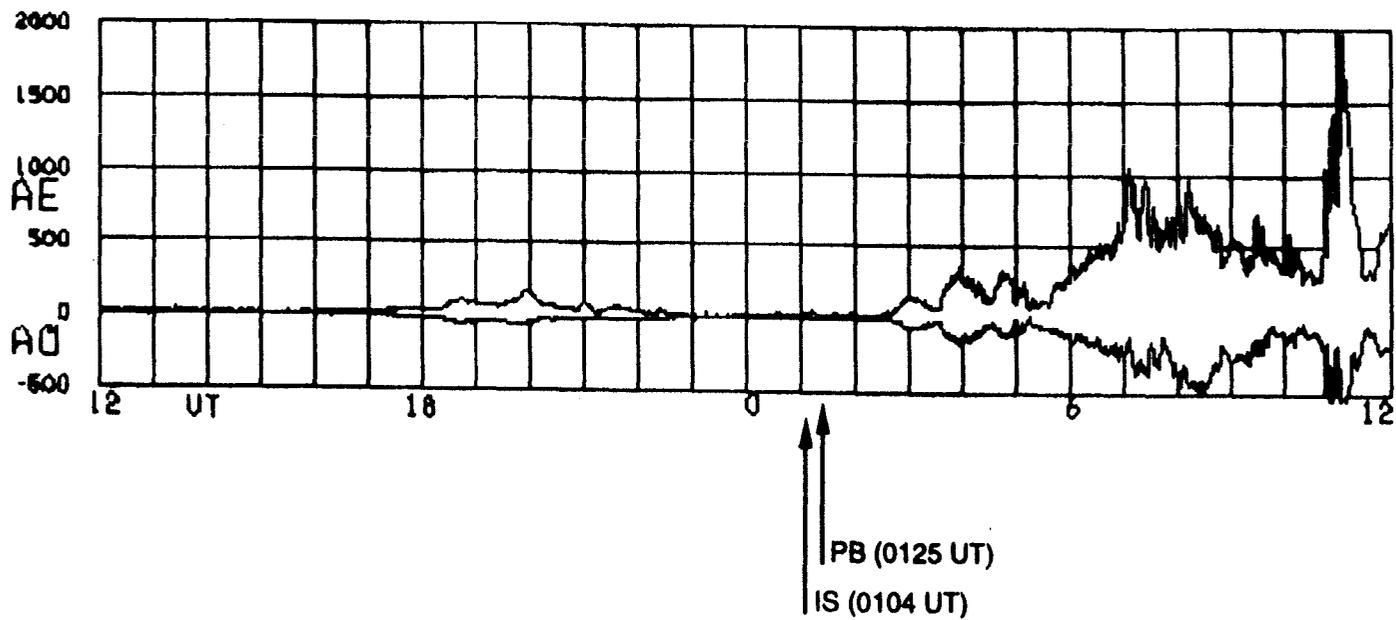
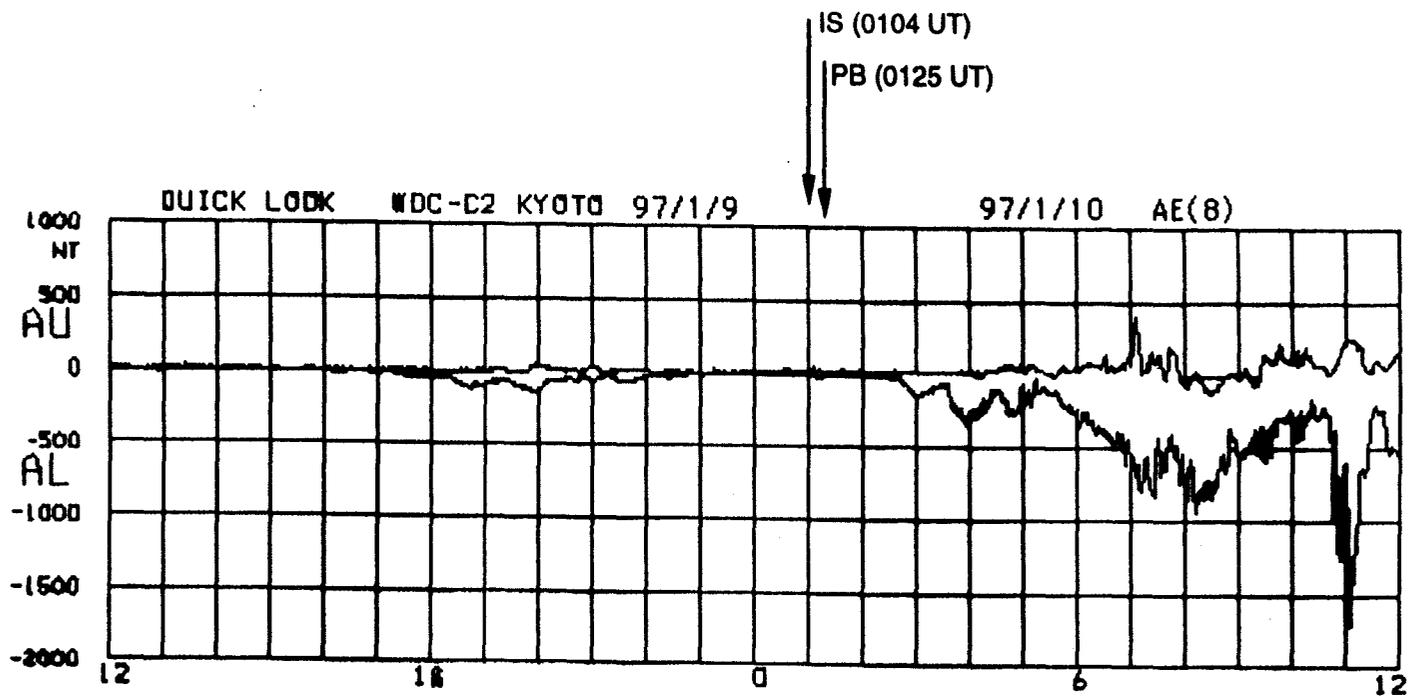


POLAR UVI LBHL September 24, 1998

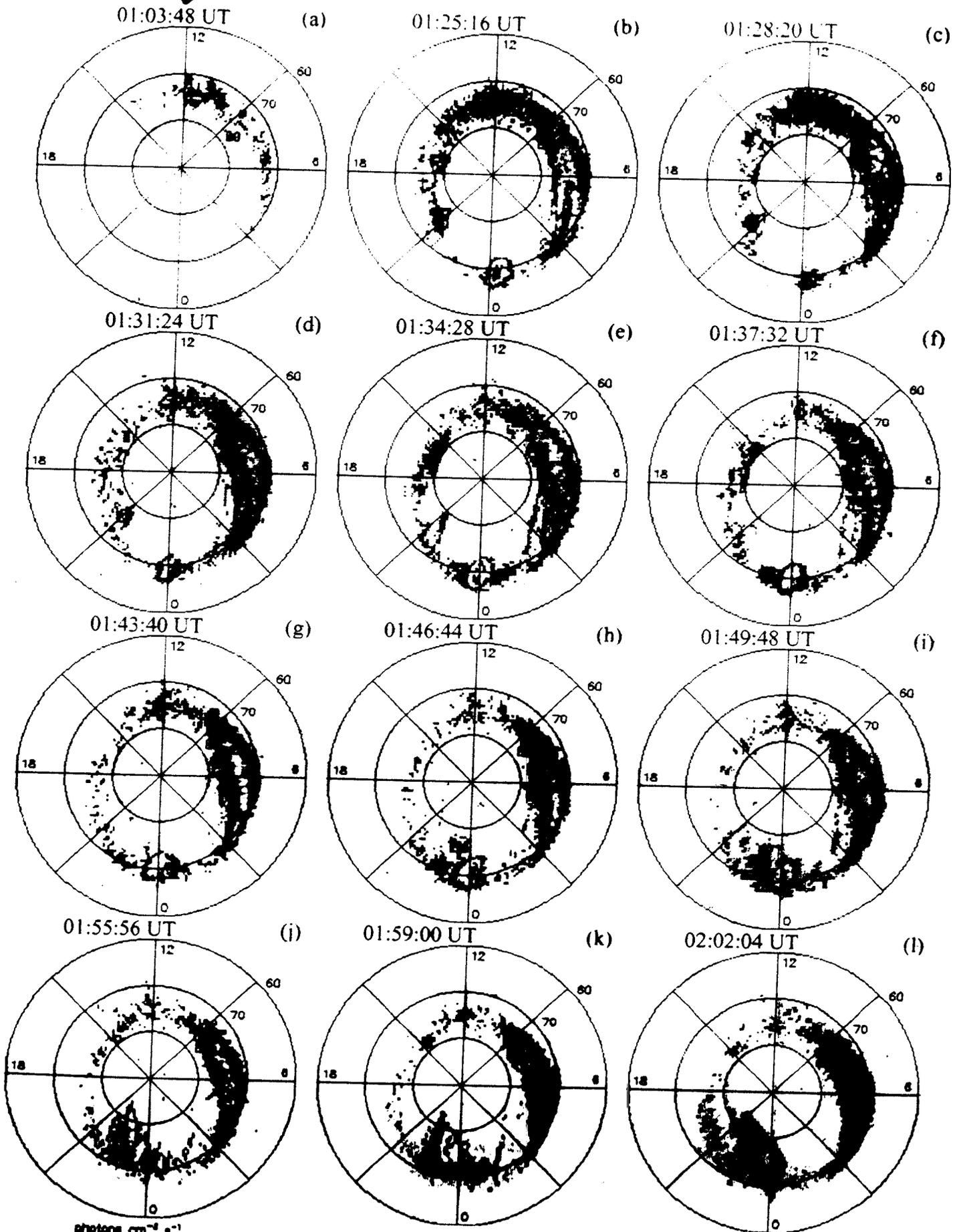
WIND - January 10, 1997



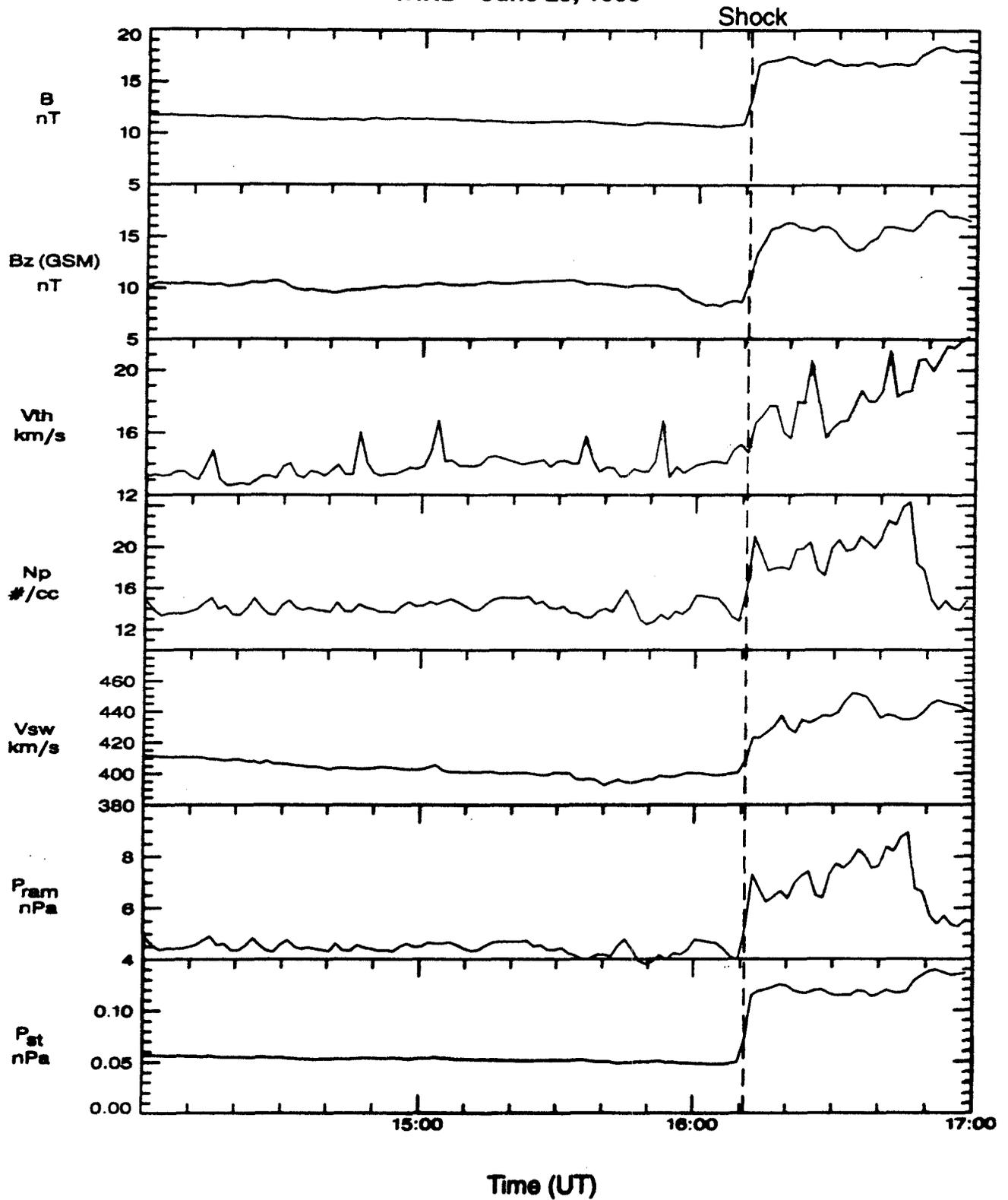
	00:00	00:58	01:00	02:00	03:00
Xgsm (Re)	84.3	84.7	85.1	85.4	85.8
Ygsm (Re)	-54.9	-54.9	-55.2	-55.8	-56.6
Zgsm (Re)	-23.3	-23.1	-22.1	-20.4	-18.1

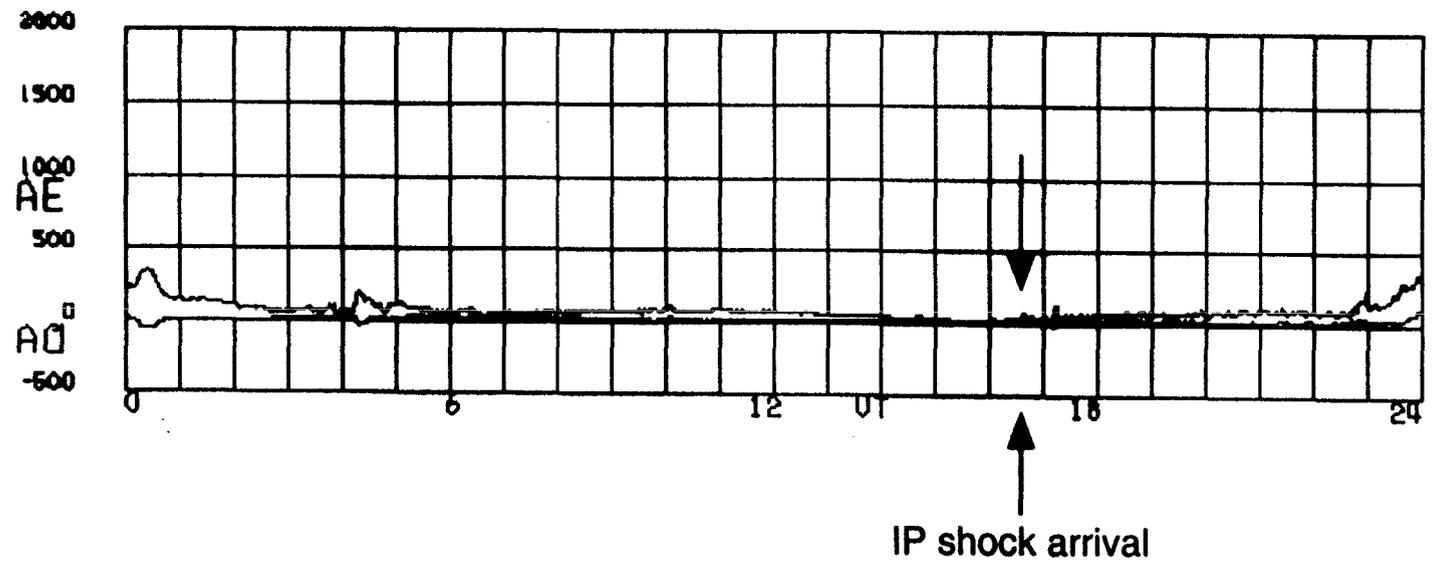
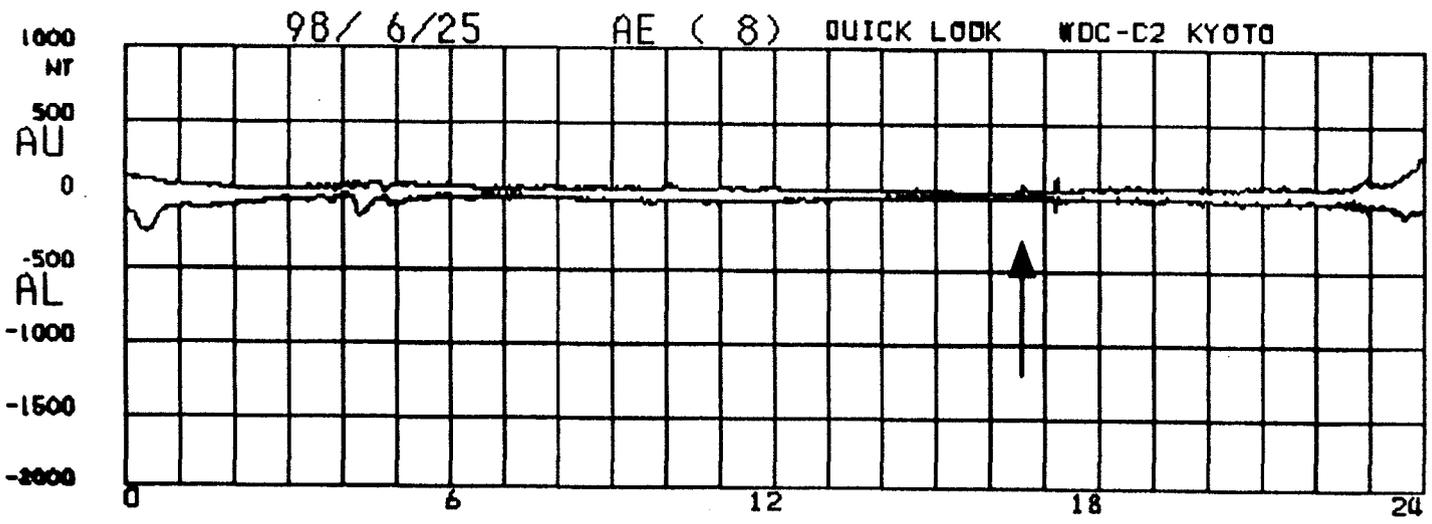


IP Shock arrival

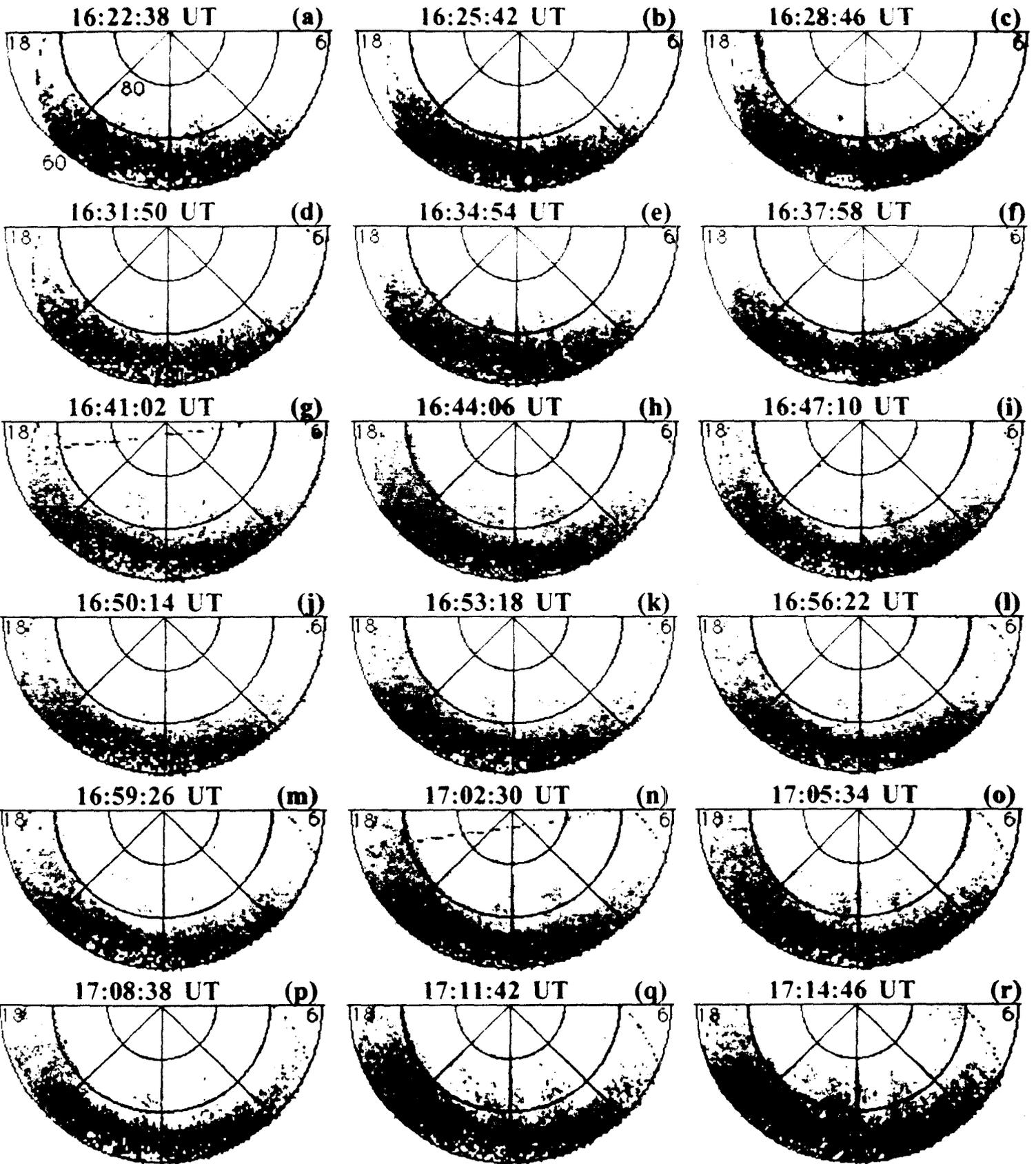


WIND - June 25, 1998

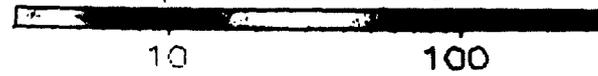




IP Shock Arrival



photons $\text{cm}^{-2} \text{s}^{-1}$

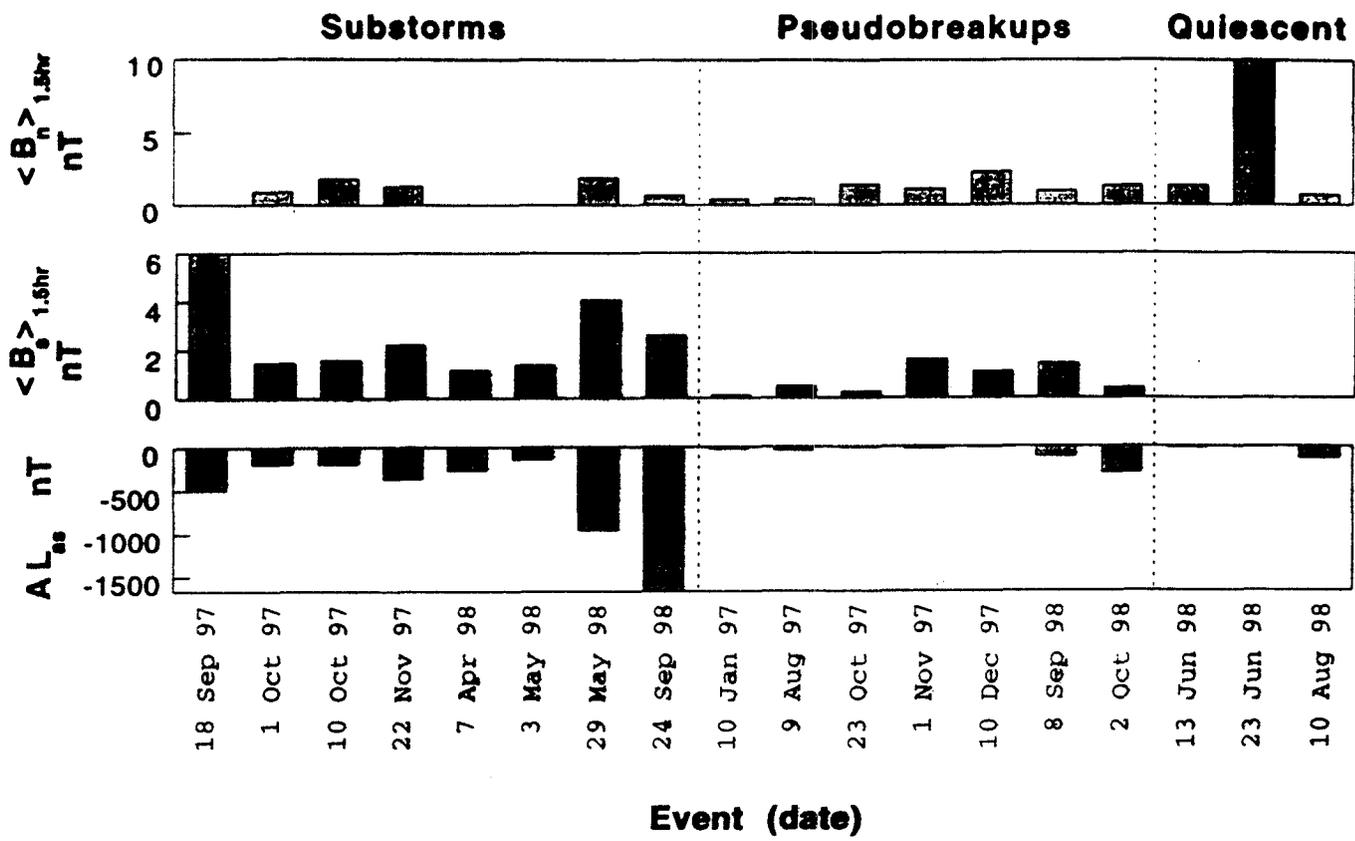


POLAR UVI LBHL

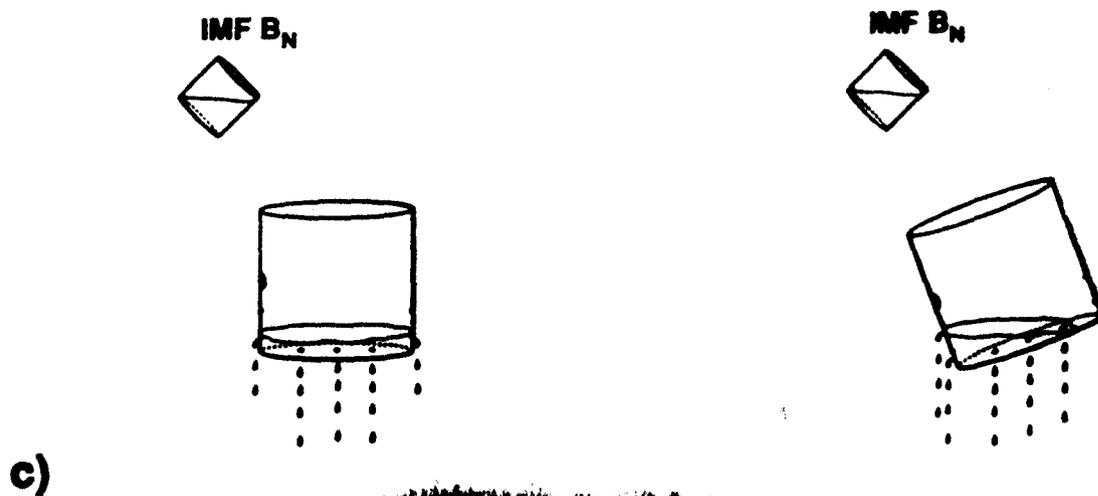
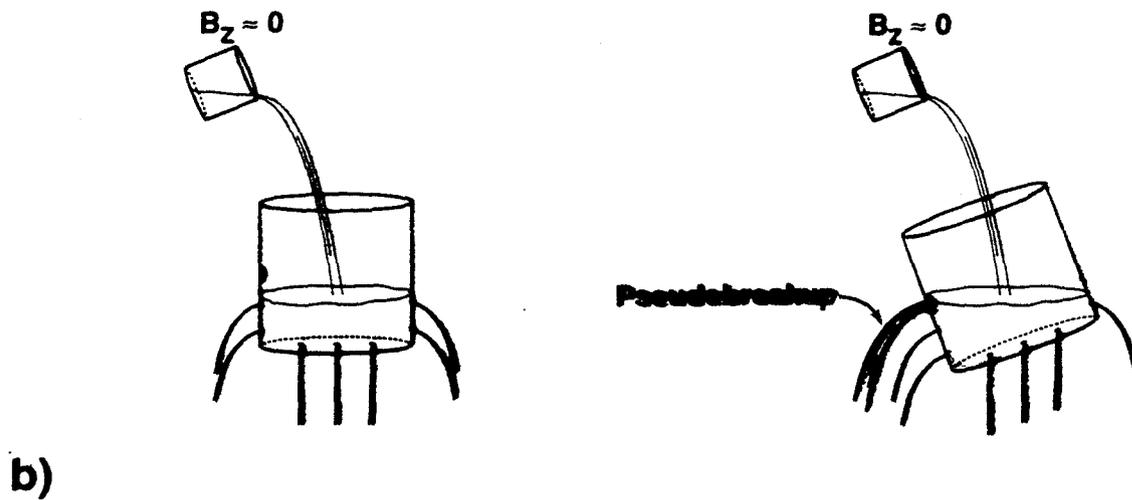
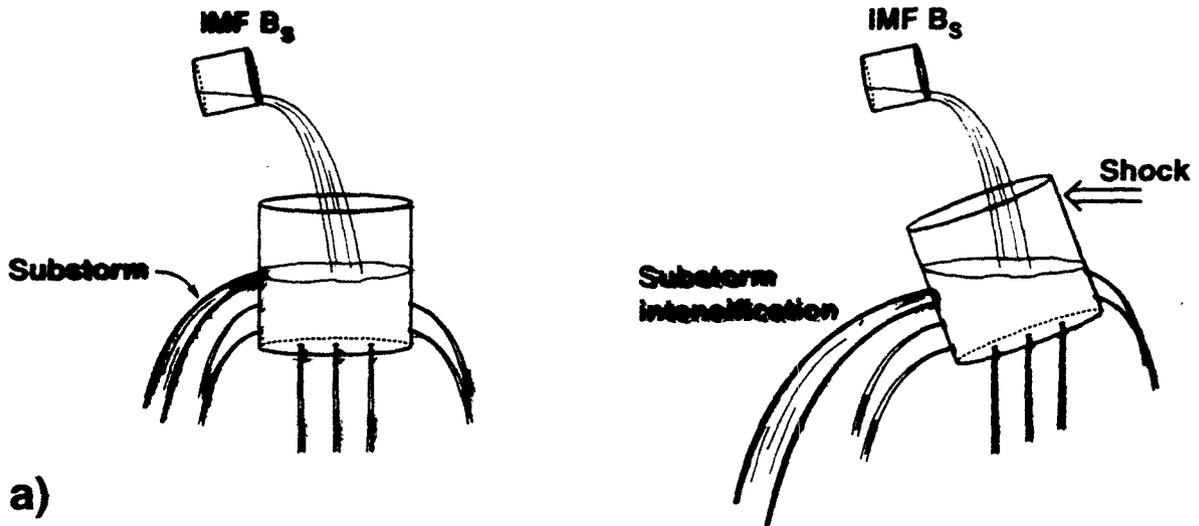
June 25, 1998

Associated IMF Bz turning events
(Within expected time \pm 15 min)

Type	Date	IMF Bn (nT) Events	IMF Bs (nT) Events
	Sep 18, 1997	No	No
	Oct 1, 1997	No	No
	Oct 10, 1997	Yes	No
	Nov 22, 1997	No	No
SS	Apr 7, 1998	No	No
	May 3, 1998	No	No
	May 29, 1998	No	Yes
	Sep 24, 1998	Yes	No
	Jan 10, 1997	No	No
	Aug 9, 1997	Yes	No
	Oct 23, 1997	No	No
PB	Nov 1, 1997	No	No
	Dec 10, 1997	No	No
	Sep 8, 1998	No	Yes
	Oct 2, 1998	No	No



Dripping, Tilting Bucket Model



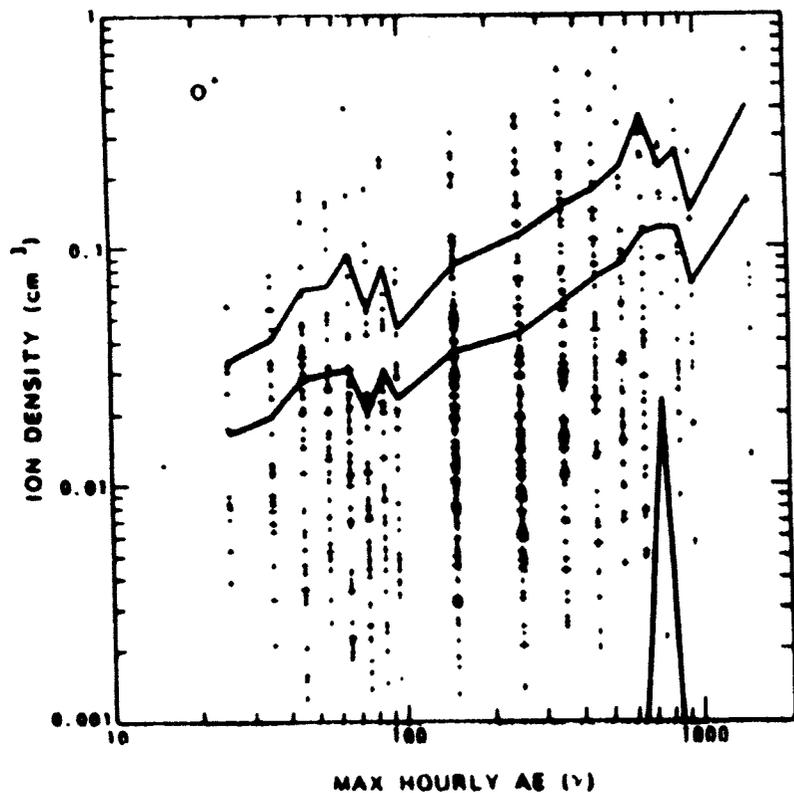


Fig. 6. A scatter plot of all the individual samples of the O^+ number density. The three lines show the average (middle line) and the average plus or minus one sample standard deviation (as opposed to a standard deviation of the average itself). The lowermost of these three is partly below scale.

Lennartsson & Shelly JGR. '98

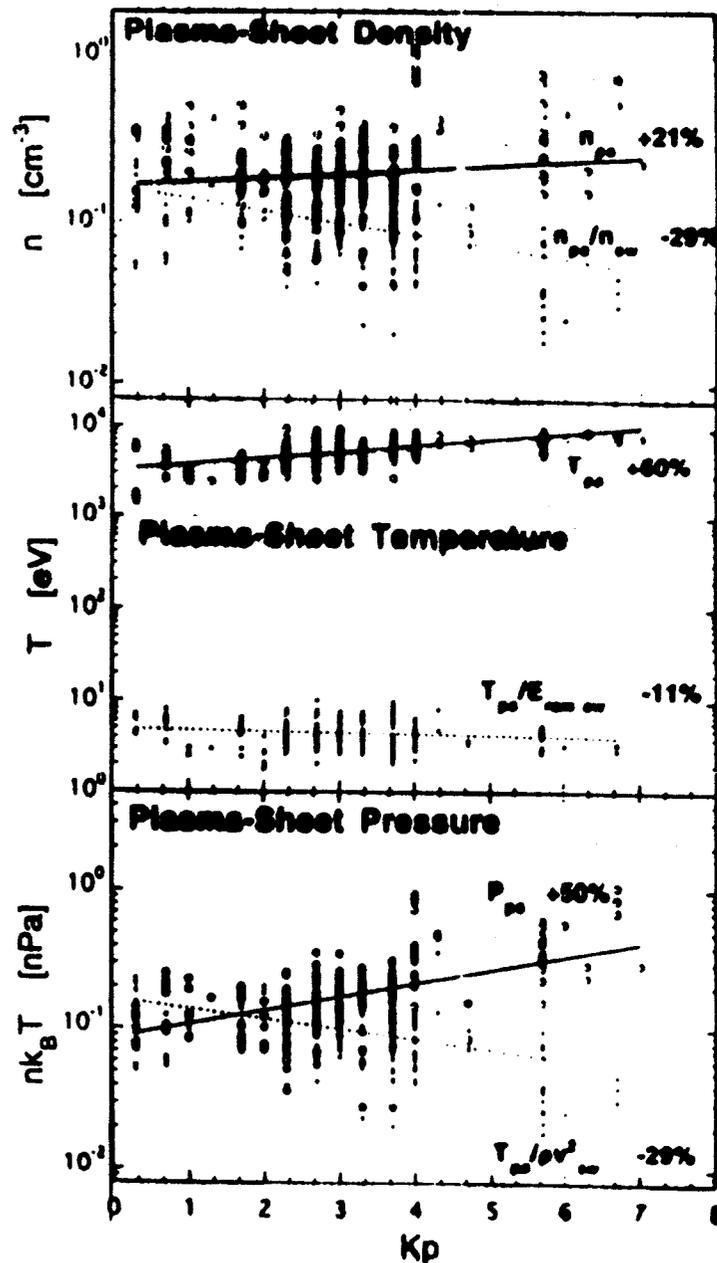
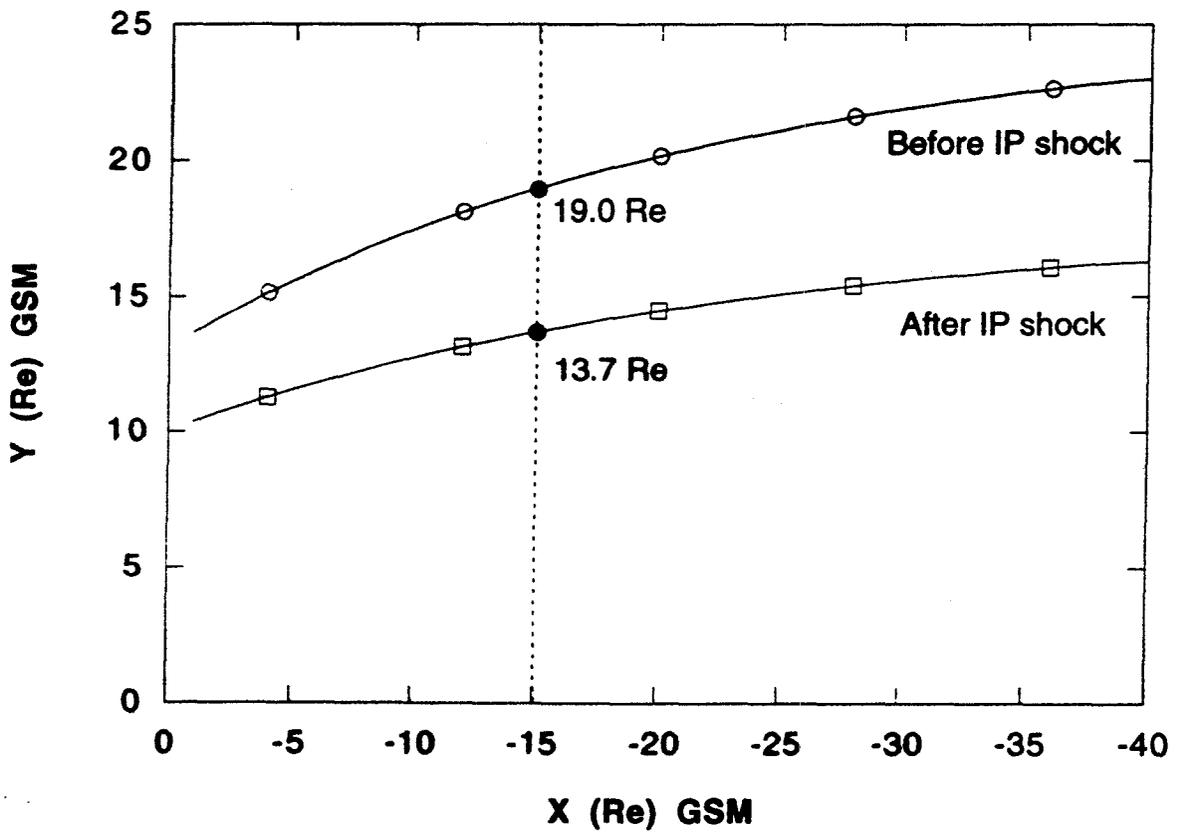
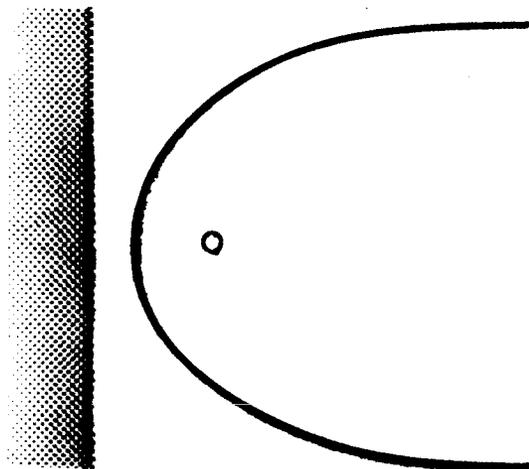


Figure 8. For neutral-sheet encounters between 17.5 and 22.5 R_E , the density, temperature, and particle pressure of the plasma sheet are plotted as functions of K_p and then normalized to instantaneous solar wind quantities and re-plotted.

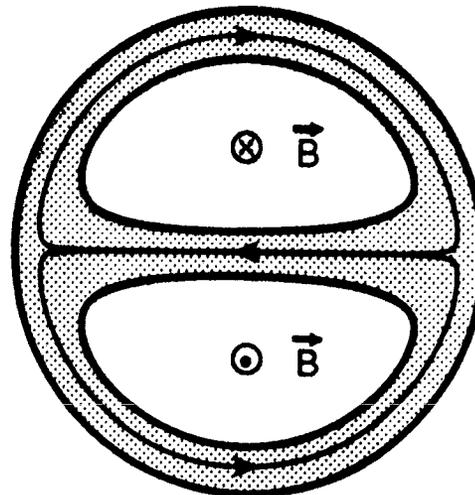
R. ... + 1 - ...



Shock front

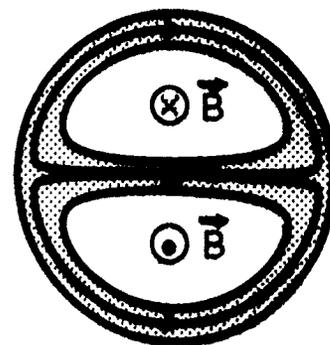
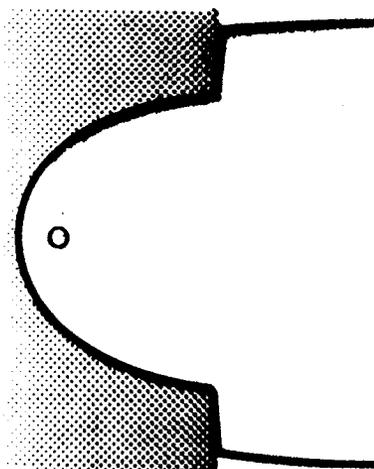


Magnetotall



(a)

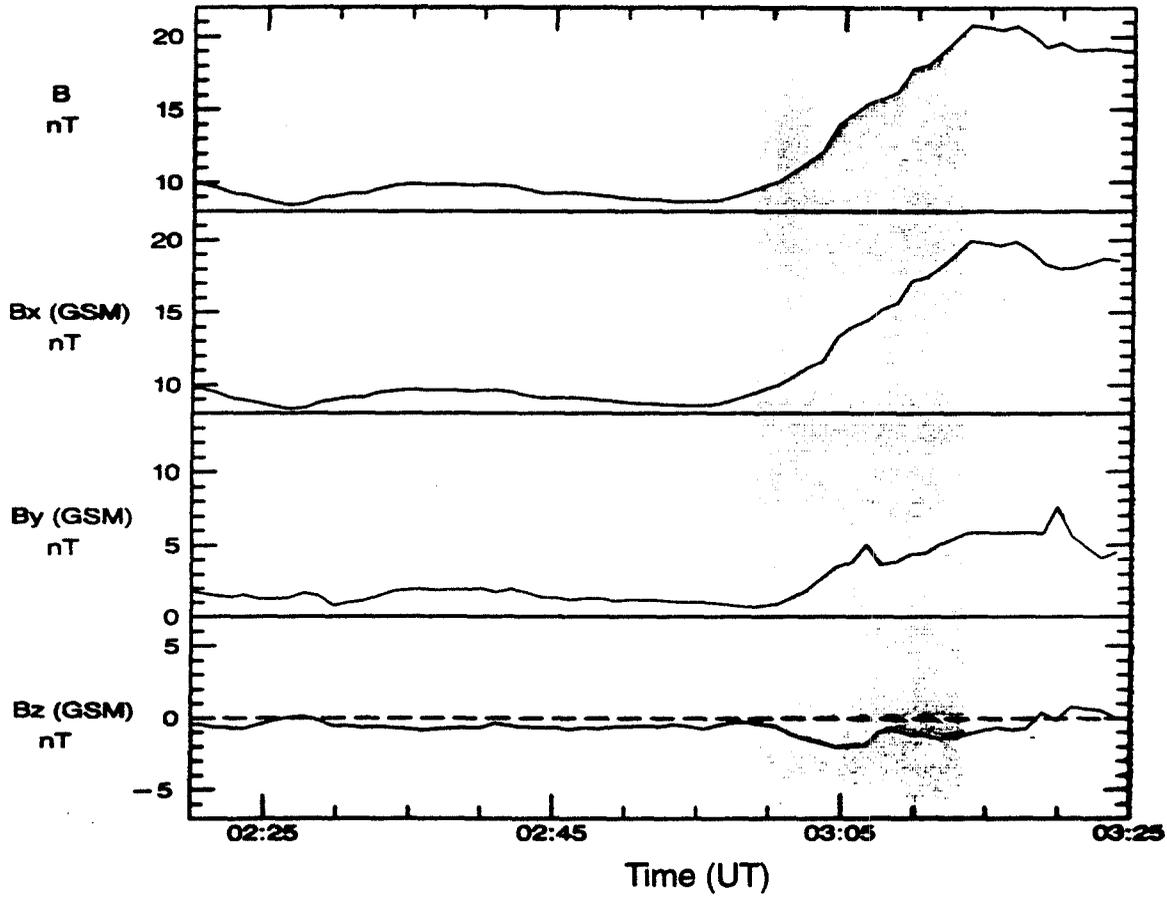
Shock front



(b)

Figure 8

IMP 8 - July 24, 1995



X (Re GSM)	-31.3	-31.2	-31.1	-31.1
Y (Re GSM)	-12.3	-12.4	-12.4	-12.4
Z (Re GSM)	8.5	8.9	9.3	9.6

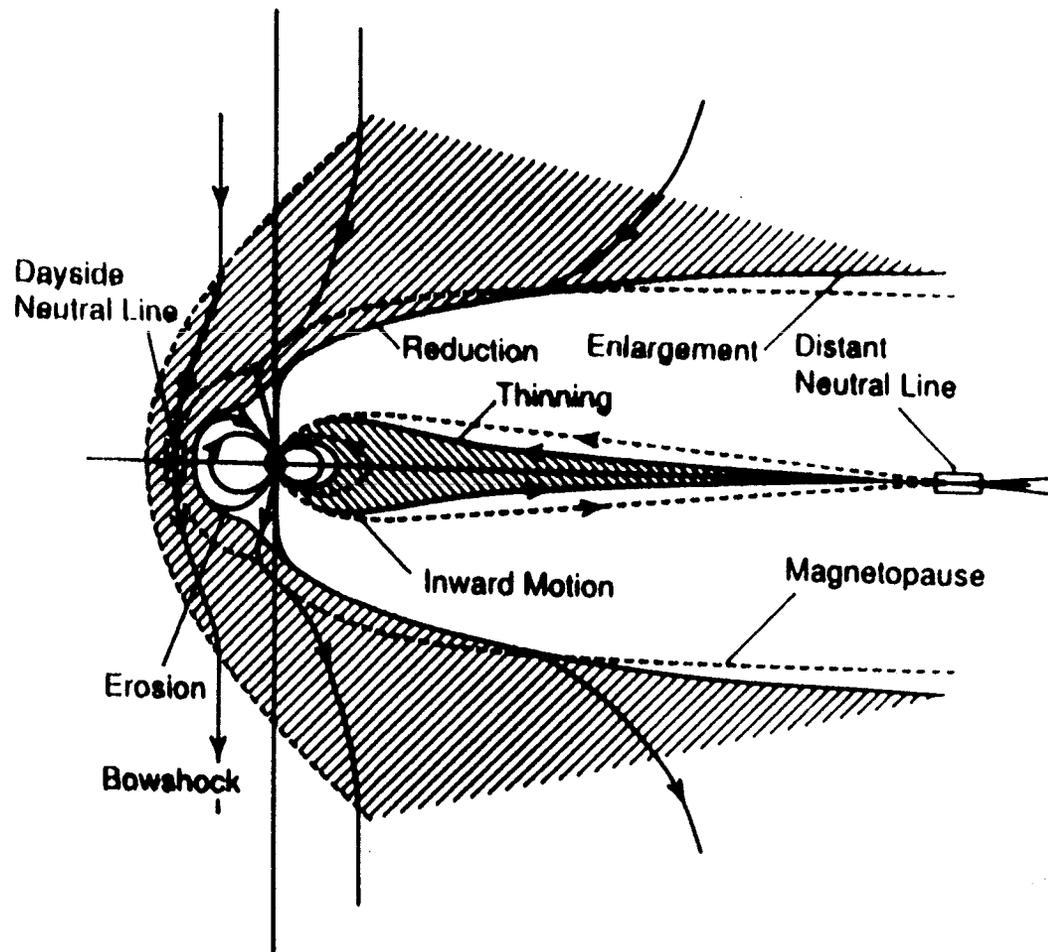
TRIGGERING MECHANISMS

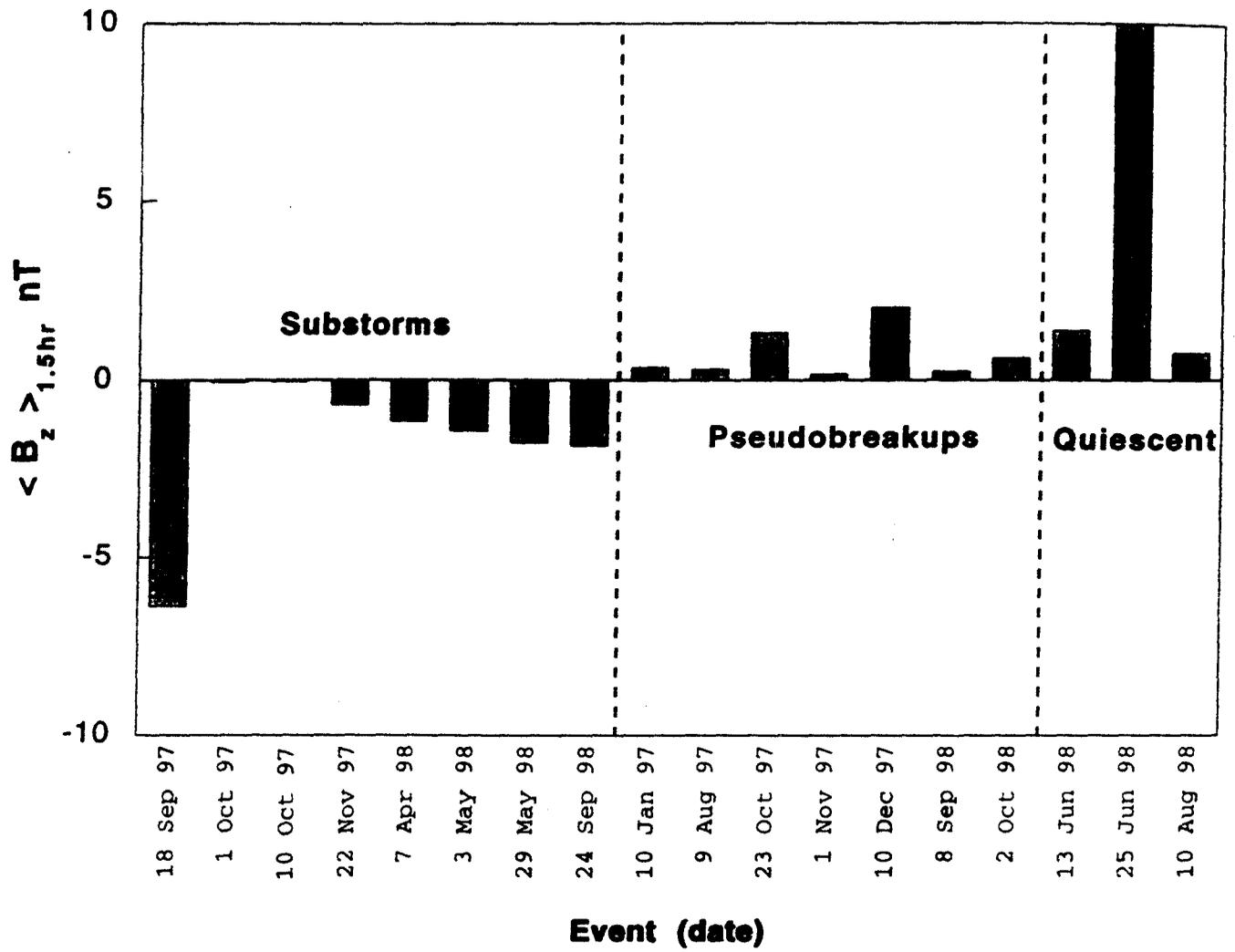
1. Magnetic Reconnection Precursor IMF B_s will lead to near-tail plasma sheet density (Lennartsson and Shelley, 1986) and thermal pressure (Borovsky et al., 1998) enhancements. Tail compression will cause cross-tail current sheet thinning and magnetic reconnection as discussed in Coroniti and Kennel (1972).
2. Current Disruption Decrease in tail diameter and also current sheet compression both lead to cross-tail current density enhancements. Plasma instabilities (Papadopoulos, 1979 and Chang et al., 1990) can lead to current sheet disruption (Lui et al., 1990).

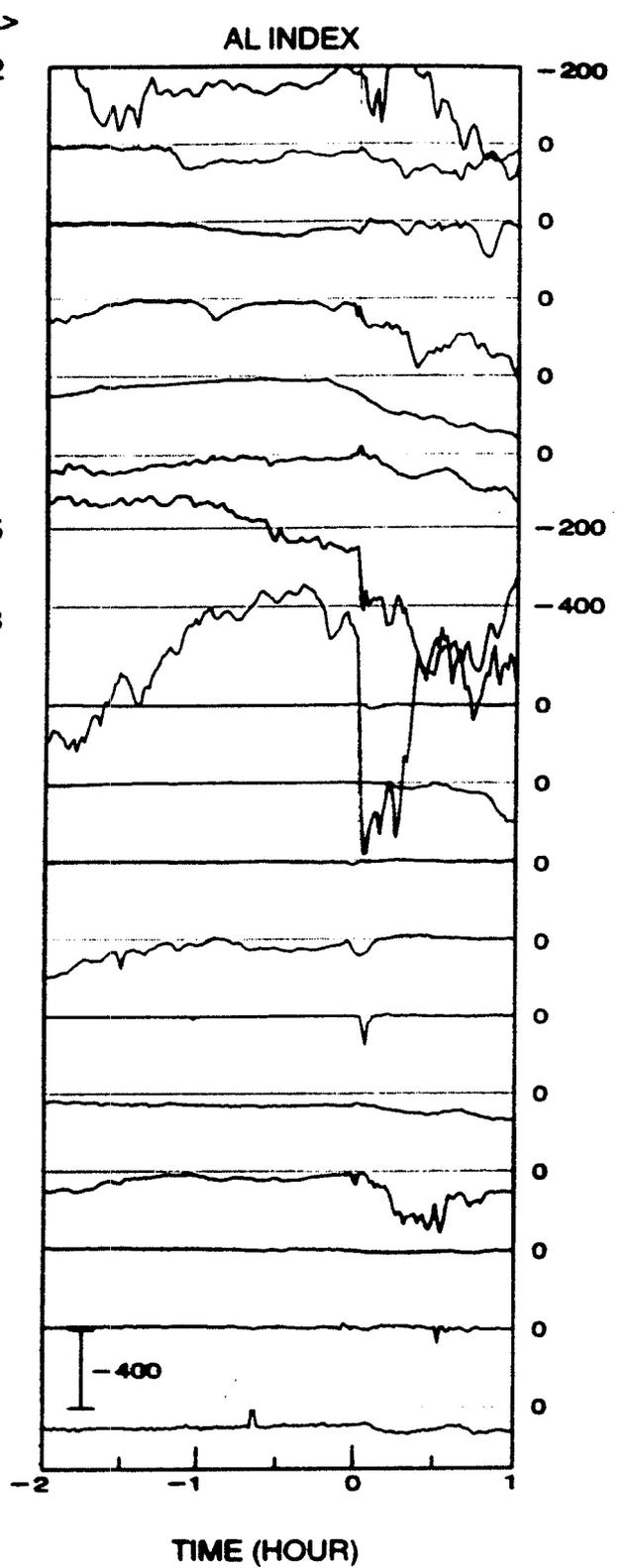
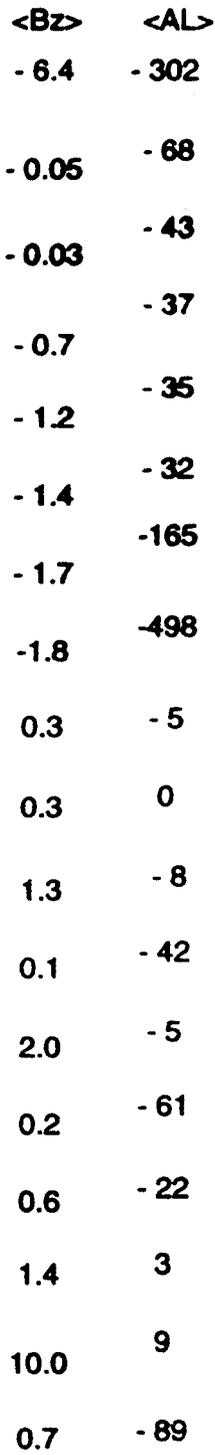
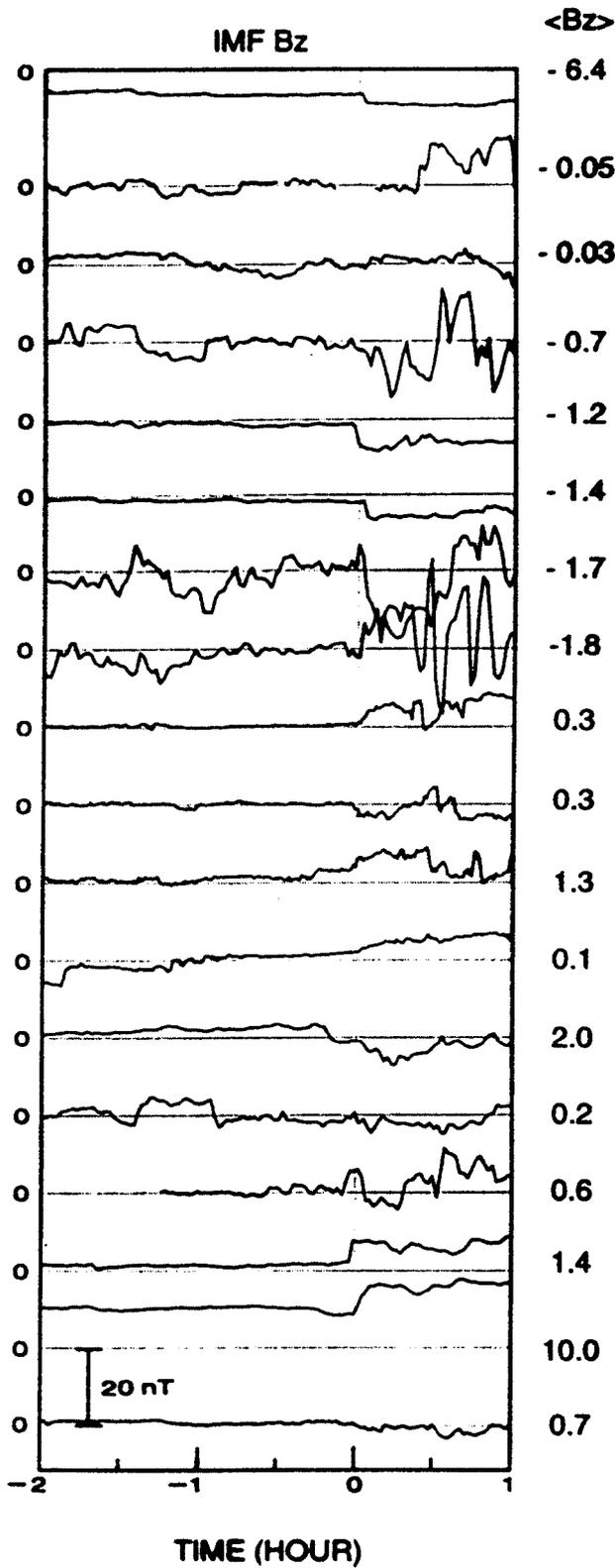
SUMMARY AND CONCLUSIONS

1. Substorm triggering mechanism can be studied using interplanetary shock events. Effects in the magnetotail are large, clear and have small time uncertainties.
2. Interplanetary precursors play a major role in the triggering of substorms, pseudobreakups or nothing (quiescent events). Shock triggering geomagnetic activity can now be predicted?
3. Effects of magnetotail compression are well understood. Specific triggering mechanisms should be tested in this light.

FIG. 13.21. Schematic illustration of the changes in magnetic field and plasma sheet expected in the situation where the reconnection rate on the dayside exceeds that on the nightside. Increased magnetopause flaring, plasma-sheet thinning, and earthward motion of the tail current are the main effects.







An IMF northward turning event is identified by:

- 1) the turning occurred after a period (≥ 30 min) of predominantly negative IMF B_z , at ≤ -2 nT.
- 2) B_z remained elevated for at least 10 min with at least one point at least 2.5 nT higher than at the turning onset.

An IMF southward turning event is identified by:

- 1) The IMF $B_z \geq 2$ nT for more than 5 hr.
- 2) and then, the IMF $B_z \leq -1.5$ nT over next one hour.

The expected time T is:

$$T = T_o - \tau - T_C$$

where τ is the delay time between magnetopause contacting and the a substorm expansion onset. For Bn event it is ~ 9 min (Lyons et al., JGR, 1997), for Bs event it is ~ 1 hr (Iyemori, JGG, 1980). We examined IMF B_z turning events in a duration of $\Delta T = T \pm 15$ min.

September 24, 1998 event

$R: 19 \Rightarrow 13.3 Re$ $(at X = -15 Re)$

$B_L \Rightarrow 2.1 B_L$ $I \Rightarrow 2.1 I (mA / m)$

$P_L \Rightarrow 4.4 P_L$ $h \Rightarrow h/1.7$ $(PV')_{CS} = const.$

$Vy \Rightarrow const.$ $Ey \Rightarrow 1.43 Ey$
